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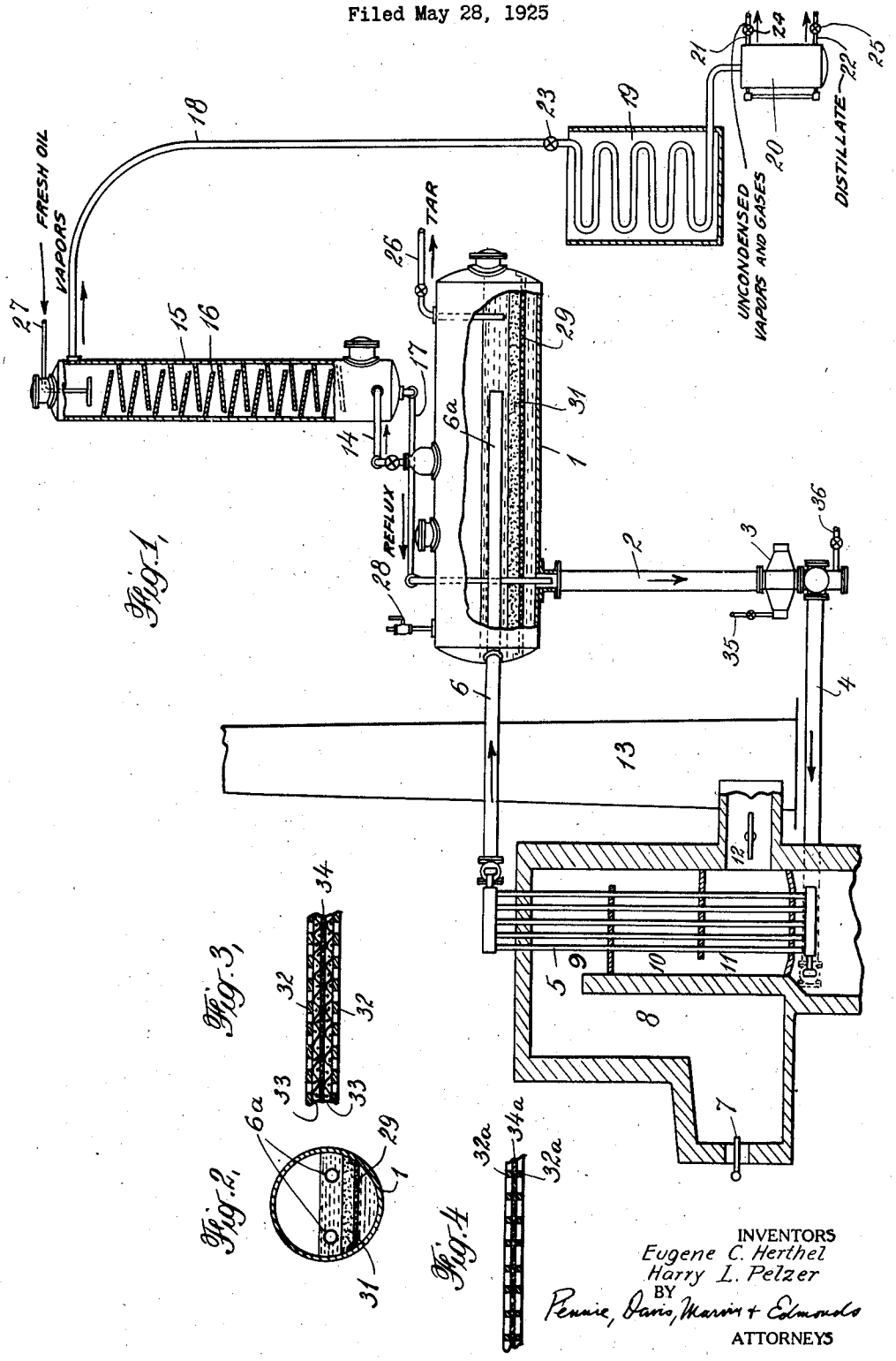


Fig. 1.

Fig. 3.

Fig. 2.

Fig. 4.

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CRACKING OF HEAVIER HYDROCARBON OILS.

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This invention relates to improvements in the cracking of heavier hydrocarbon oils for the production of gasoline or motor spirit or pressure distillate therefrom. The invention relates particularly to improvements in the operation of circulatory pressure still systems in which the oil is heated to a cracking temperature in tubular heaters. This application is in part a continuation of our copending application Serial No. 704,926, filed April 5, 1924, which has issued a Patent 1,634,666. The invention comprises an improved process which assists in protecting the heating tubes of the cracking still and which also enables the cracking operation to be continued for a prolonged period of time before the deposition of carbon begins or before it is necessary to shut down the cracking still for cleaning purposes.

In the cracking of heavier petroleum oils in pressure stills for the production of gasoline or pressure distillate therefrom there are formed during the cracking operation certain constituents of an asphaltic or pitch-like character. With continuation of the cracking operation, the amount of such constituents increases and there is a tendency for deposit of carbon or coke to form on the heated surfaces of the still, thus necessitating the shutting down of the still for cleaning purposes between successive runs. The shutting down of a pressure still, the withdrawal of the charge therefrom, the cleaning of the still, the recharging of the still and the preliminary heating of the still to bring the fresh charge up to cracking conditions, all require time, and the total amount of time so required in ordinary commercial operations means a corresponding reduction in the proportion of the time when the still is operating for carrying out the desired cracking operation.

According to the present invention, the deposition of pitch or carbon in the heating tubes of the pressure still is retarded or reduced so that overheating or danger of failure of the heating tubes can be effectively prevented, and the time of operation of a single run can be somewhat prolonged, with correspondingly less loss of time and greater production per still per day.

When a pressure still is charged with gas oil or other charging stock to be subjected to cracking, and when the charge is heated to the cracking temperature, the cracking takes place in a gradual and progressive manner. The lighter constituents produced by the cracking operation, which go to make up the pressure distillate, are removed from the still progressively during the cracking operation. Other constituents, such as heavier hydrocarbons formed by the cracking operation, may remain and mix with the charge of the still. A small amount of asphaltic or pitch-like constituents is progressively formed. Such constituents appear to be of varying properties and characteristics. For the most part they remain in solution in the charge during the early portion of the run, and they may remain completely in solution during the early portion of the run. With gradual and progressive cracking of the charge however the amount of such asphaltic or pitch-like constituents gradually and progressively increases until sooner or later the amount of such constituents increases beyond the saturation point. Furthermore, certain of these constituents, which appear to be relatively small in amount as compared with the total amount of the pitch-like constituents formed, appear to be of a different character and to have an increased tendency to deposit on the heating surfaces of the still. Furthermore, as the charge becomes supersaturated with the less objectionable pitch-like constituents, there is an increased danger of deposit of pitch or carbon on the heating surfaces of the still, with corresponding danger of overheating and failure of the heated surfaces if the still is not shut down at more or less frequent intervals to remove this deposit.

Among the constituents produced by the cracking operation which seem to be particularly objectionable are certain of the sulfur-containing compounds. With charging stock which contains sulfur, certain of the sulfur compounds appear to undergo cracking to form sulfur-containing constituents, probably of an asphalt-like character, which are particularly objectionable. Analyses of the carbon deposit on the heating tubes of a cracking still indicate that certain of these sulfur-containing constituents have a preferential affinity for the heated surfaces, or tend to separate out on such surfaces, to give a deposit containing both iron and sulfur in pro-

portions approximating those of iron sulfide. It may be also that asphalt-like constituents of a colloidal character, or even colloidal carbon, formed as a result of the cracking operation, tend to separate out in the heating tubes of the still in a preferential manner.

The present invention relates more particularly to an improved method of cracking heavier oils in tubular pressure stills in a batch or semi-continuous operation, and involves the maintenance within the pressure still of a body of fuller's earth in direct contact with the still charge through which the still charge is circulated during the cracking operation.

We have found that the length of time during which the operation of a tubular pressure still can be continued can be somewhat prolonged by maintaining within the pressure still a body of fuller's earth, in direct contact with the still charge, and by causing the still charge to circulate repeatedly through said body of fuller's earth during the progress of the cracking operation. We have also found that the maintenance of a body of fuller's earth within the still charge is of advantage in protecting the heating tubes of the still from corrosion, overheating and burning out, and in reducing carbon deposition upon the heating surfaces, whether or not the operation is carried out over a prolonged period.

The bed of fuller's earth which is maintained in the still in contact with the charge, and through which the charge is continuously circulated, does not remove from the charge all of the pitch-like constituents; but it has a selective action upon certain of these constituents, and apparently removes those constituents which are particularly objectionable from the standpoint of forming a carbon deposit on the heating tubes of the still. This selective action may be in part a filtering action, or a selective absorbent action for colloidal carbon or precipitated asphalt-like constituents, or sulfur containing constituents, etc. Whatever the explanation of the action of the fuller's earth may be, it has an important protective effect in preventing objectionable carbon deposit. The fact that without the fuller's earth the carbon deposit contains an important and relatively large percentage of sulfur, whereas in the process of the present invention such objectionable sulfur containing deposit is avoided, or reduced, indicates that the fuller's earth has a selective desulphurizing action upon the pressure still charge, selectively removing therefrom certain of the objectionable sulphur containing constituents of the charge. It is also probable that constituents of an asphalt-like character produced by the cracking operation and which tend to separate out from the charge as suspended particles are removed from the circulating charge by the filtering or selective absorbent action of the fuller's earth bed.

The entire body of oil charged into the pressure still, for example gas oil, serves to hold in solution up to the point of saturation the pitch-like constituents that are formed In the process of the present invention, however, only the pitch-like constituents which are not removed by the fuller's earth bed remain to be held in solution in the charge, and the fuller's earth, in addition to its selective action upon the charge, apparently increases the amount of pitch-like constituents which the charge will hold in solution. Where no tar is withdrawn during the operation, or where a relatively small amount of tar is withdrawn, the pitch content gradually increases and approaches the saturation point, and during the latter portion of the operation, the pitch concentration may reach and even greatly exceed the saturation point in the remaining oil of the still charge. Where fresh charging stock is introduced during the cracking operation, this also assists in holding the pitch-like constituents in solution, but as part of the fresh charging stock is cracked and as additional portions of the charge already in the still are also cracked, the increased solvent effect of the fresh charging stock is overcome and the unvaporized portion of the fresh charging stock also becomes progressively saturated. In the improved process of the present invention, part of the pitch-like constituents produced during the cracking operation are removed by the action of the body of fuller's earth, and, in some cases, the saturation concentration of pitch-like constituents in the still charge may also be increased. This latter possibility is apparently due to the character of the components of the charge removed by the body of fuller's earth, and to a selective action of the earth upon certain of the constituents of the charge which tend to cause rapid precipitation of pitch-like constituents and also to the fact that those pitch-like constituents not removed and remaining in the charge are less injurious. In either batch or semi-continuous operation, the cracking operation is terminated when, or before, the amount of pitch-like constituents remaining in the charge, above the amount removed by the fuller's earth bed and any amount withdrawn as tar, increases to a point where objectionable deposition will take place in the heating tubes of the still.

In the process of the present invention, accordingly, both the nature of asphaltic or pitch-like constituents contained in the charge circulated through the heating tubes is controlled and the amount of such constituents or the rate of formation of such constituents is somewhat restricted, the selective action of the fuller's earth removing what we

consider to be the more objectionable constituents and permitting a higher concentration of less objectionable pitch-like constituents in the charge. Such pitch-like constituents as remain in the circulating charge, after its passage through the fuller's earth bed, and up to the point where objectionable deposition begins, we consider to be held in solution in the circulating charge.

In one particularly advantageous way of carrying out the improved process of the present invention, fuller's earth is maintained in the form of a bed extending across the drum or bulk supply tank containing the main charge of oil, and the oil is circulated from such drum through heating tubes and back to the drum. The fuller's earth is supported in the form of a bed through which the entire charge can be circulated, and the still is provided with circulating means for circulating the charge through the fuller's earth bed. The fuller's earth is also supported out of contact with the heating surfaces of the still, and provision is made for circulation of the oil through the heating tubes as well as through the fuller's earth bed. The circulating charge thus circulated through the heating tubes thus contains only the constituents which are not removed by the circulation through the fuller's earth bed. The provision of a large bed of fuller's earth within the pressure still itself has the advantage that a large surface area of the earth is exposed to the charge, and a large area of earth bed is provided for circulation of the charge therethrough. The pressure still construction need not be changed by the provision of additional external equipment; but tubular circulatory pressure still systems of present day construction can readily be provided with a perforated support extending across the interior of the still for supporting the bed of earth in contact with the still charge. The heating tubes may be either horizontal or vertical, and may be in either bank or continuous arrangement with mass or stream circulation. The tube still may thus be one in which there is stream circulation through a series of tubes in the form of a continuous stream; or the circulation may be in parallel through a large number of heating tubes. The still may be one in which thermal action is relied upon to cause the circulation of the charge through the heating tubes, or it may be one in which the circulation through the tubes is effected by mechanical means, such as a circulating pump. In such tubular stills the circulation of the charge through the heating tubes and through the bed of fuller's earth in the bulk supply tank or drum results in causing all portions of the circulating charge to pass through the bed of earth in the bulk supply tank before they recirculate through the heating tubes, while the charge in the bulk supply tank is in contact with a large area of the fuller's earth through which the charge is circulated.

The invention will be further described and illustrated in connection with the accompanying drawing which shows in a somewhat conventional and diagrammatic manner, one form of tubular pressure still embodying the invention and adapted for the practice of the process of the invention; but it is intended and will be understood that the invention is not limited to the specific construction and operation so described.

In the accompanying drawing, Fig. 1 shows, in a somewhat conventional and diagrammatic manner, and with part in section and part in elevation, one arrangement of a tubular pressure still embodying the invention and adapted for carrying out the process of the invention;

Fig. 2 is a sectional view of the drum or bulk supply tank of Fig. 1;

Fig. 3 is an enlarged detailed sectional view of one form of screen support by which the fuller's earth or like material is supported in the still; and

Fig. 4 is a similar view of a modified construction of screen support.

The pressure still illustrated comprises the shell or bulk supply tank 1 having an outlet pipe 2 leading to the pump 3 by which the oil is pumped through the lower connecting pipe 4 to the distributing pipes and headers of the vertical tubes 5. From these tubes the oil is returned through the upper headers and connecting pipes and the return lines 6 to the bulk supply tank 1. The vertical tubes 5 are shown as enclosed within a furnace having one or more burners 7 adapted to be heated by gas or oil, the main furnace chamber 8, and three passes 9, 10 and 11 separated by baffles for causing the furnace gases to pass over the vertical tubes in a back and forth manner before they escape through the connecting flue 12 to the stack 13. From the drum 1 of the pressure still a vapor line 14 leads to the reflux tower 15 which is shown as a baffle tower having a series of baffles 16 therein. This tower has a return pipe 17 leading from the bottom and discharging into the outlet pipe 2. The vapor line 18 leads from the top of the reflux tower 15 to the condenser 19 from which the condensate and uncondensed gas are collected in the receiver 20. Draw-off pipes 21 and 22 are provided for drawing off the uncondensed gas and the condensate respectively from the receiver 20. A pressure regulating valve 23 is provided between the still and condenser, or the pressure can be regulated by means of the valves 24 and 25 in the outlet pipes from the receiver 20. A tar draw-off line 26 is provided; as well as a safety valve 28. A feed line 27 is shown for introducing fresh charging stock into the upper portion of the reflux tower.

Within the still is provided a perforated support 29 suitably secured to the shell of the drum, e. g., by welding, and upon this perforated screen or support is maintained a relatively deep body of fuller's earth or like absorbent material indicated at 31. A cross-section of one suitable form of screen support is illustrated in Fig. 3. This is made up of five layers, a top layer 32 of e. g. 3/8" thick plate with 1/2" perforations, a 4 mesh screen 33, a 40 mesh screen 34, another 4 mesh screen 33 and another 3/8" thick steel plate 32 with 1/2" perforations therein. A modified and simpler form of support is illustrated in Fig. 4, made up of the upper and lower perforated plates 32^a having the screen 34^a between them. The nature of this support can be varied so long as it performs the function of supporting the earth without leakage. Where finely divided earth is used, the support should be sufficiently fine to prevent escape of the earth therethrough. We have found it advantageous, however, to use relatively coarse fuller's earth, e. g. earth of 15 to 30 mesh, in conjunction with a coarser supporting means. It will be noted that the perforated support and screen form a floor over the bottom of the still. With such a screen, thoroughly sealed by welding or riveting at the joints and secured to the walls of the still, the earth placed upon the support cannot leak past it and collect in the circulating system, but is all maintained in the upper portion of the drum above the screen. With a tubular cracking still of the character illustrated, and with the bulk supply drum about 9 ft. in diameter, the perforated floor may advantageously be located approximately 2 ft. above the bottom of the drum, and a bed of fuller's earth of for example 10 to 18 inches in depth and containing about 4 to 7 tons of earth may advantageously be used, although the depth and amount of the earth can be varied.

From Fig. 1 it will be noted that the return pipes 6 extend a considerable distance into the drum 1 and terminate in extensions 6^a discharging to the remote end of the drum from that at which the outlet 2 is arranged. Where the velocity of the oil discharged from the pipe 6^a is such as to cause erosion of the bed of fuller's earth, this bed can be protected by a plate at the point of greatest velocity so as to prevent objectionable erosion.

In the operation of the pressure still, and in the carrying out of the cracking process of the present invention therein, the still is charged and heated to the cracking temperature and pressure. The still may be charged for example through the charging line 36 which may also serve as a tar draw-off at the end of the run. During the cracking operation, the oil is circulated by the circulating pump 3 from the bulk supply tank 1 through the connecting pipes 2 and 4 to the heating tubes 5 and then back through the pipes 6 and 6^a to the drum 1, discharging into this drum at the far end. Vapors from the oil are released in the bulk supply tank and pass up through the vapor line 14 into the reflux tower where the heavier ends are condensed by fresh oil introduced into the top of the reflux tower through the feed line 27, and pass with such feed through the reflux tower and the run-back line to the pump circulation. The uncondensed vapors pass through the vapor line from the reflux tower through the pressure control valve to the usual condenser and receiver. Additional feed can be introduced through the bearings of the pump by means of a feed line 35. The charge is withdrawn from the drum below the perforated support and is circulated through the heating tubes and back to the drum or bulk supply tank above the perforated support. The unvaporized portion of the charge, before it can again be withdrawn and passed through the heating tubes, must pass downwardly through the bed of earth, and the bed of earth thus has an opportunity of exerting its selective absorbent action upon the objectionable asphaltic or pitch-like constituents of the charge. In the apparatus illustrated it will be noted that the bed of earth is below the normal liquid level and is completely submerged or immersed in the body of the charge and that it provides a large surface area in contact with the charge and a large sectional area through which the charge can flow downwardly at a relatively reduced rate as compared with the rate of circulation through the heating tubes. Ample opportunity is thus provided for the earth to exert its selective absorbent action as the charge is slowly circulating or filtering downwardly therethrough.

The bed of absorbent material is not, however, relied upon alone to take care of the pitch-like constituents formed by the cracking operation up to the saturation point, or somewhat beyond the saturation point, in the remaining solvent constituents of the original charge. In the apparatus illustrated it will be noted that the fresh feed introduced through the reflux tower and also the refluxed vapors from the still are returned to the outlet pipe 2 from the bulk supply tank and that additional feed may be introduced through the pipe 35 and the pump bearings. The circulating charge, therefore, is made up of the fresh feed and reflux together with such portion of the still charge itself as percolates downwardly through the bed of absorbent material. The oil after circulation through the heating tubes is discharged into the upper compartment of the bulk supply tank above the bed of absorbent material. The cracking operation may also be prolonged by withdrawing through the line 26 from the body of oil above the bed of absorbent material part of the pitch-laden oil

formed by the cracking operation as the pitch content of the charge increases.

The absorbent action of fuller's earth or like material is such that an increased percentage of the charge, including any fresh oil introduced during the operations, can be taken off as pressure distillate, and the pitch-content of the circulating charge can be carried to an increased amount during the run without objectionable carbon deposit on the heating tubes. As the pitch content of the charge approaches saturation, the removal from the circulating charge of the constituents which are removed by the fuller's earth prolongs the period of operation preceding saturation and enables the operation to be continued for a much longer period of time without objectionable carbon deposit on the heating tubes. Even where the pitch content is carried to a point considerably above saturation, the fuller's earth will remove from the circulating charge objectionable constituents which would otherwise tend to separate out in the heating tubes.

The fuller's earth of commerce is obtained in varying degrees of fineness. The finest grades of earth such as are commonly used for oil refining, are not so well adapted for use in the process of the present invention as the coarser grades, e. g., from 15 to 30 mesh, which permit ready flow of the circulating oil therethrough, and which do not tend to leak through the supporting screen and enter the circulating stream of oil. We have found Olmstead earth of 15–30 mesh well adapted for use in the process of the invention. Fuller's earth is of a clay-like character, and may be considered as an absorbent clay. Other absorbent clays having similar properties can similarly be used in the process of the invention. In so far as the action of the fuller's earth is a filtering action in which the earth absorbs or otherwise holds particles of colloidal carbon or asphaltic constituents, etc., thus removing them from the circulating charge, other filtering materials can be used to obtain similar results. Other absorbent materials, having a similar selective absorbent action upon the objectionable asphaltic or pitch-like constituents of the circulating charge can also be used. So also, from the standpoint of the desulfurizing action of the fuller's earth, other porous or finely divided materials having a similar desulfurizing action can be used to remove or assist in removing in a selective manner the objectionable sulfur-containing constituents of the circulating charge, for example, silica gel. Our use of fuller's earth indicates it to be a particularly advantageous material for use in the process of the invention, inasmuch as it appears to combine in itself valuable filtering, selective absorbent, desulfurizing and other properties which favorably affect and benefit the pressure still operation.

In carrying out a run according to the present invention, the still can be charged with fresh charging stock in the usual way. The charging stock may, for example, be gas oil or other suitable charging stock which is to be cracked for the production of gasoline or pressure distillate therefrom. The still charge is brought to the required cracking temperature and pressure in the usual manner. After the cracking temperature is reached, cracking begins and takes place in a gradual and progressive manner, the lighter vapors forming the pressure distillate passing off and being removed from the still, while the heavier vapors are refluxed back to the still. The asphaltic or pitch-like constituents formed are in part absorbed by the fuller's earth and in part held in solution in the remaining constituents of the charge. As the reaction proceeds the unabsorbed pitch constituents continue to dissolve in the oil and progressively approach, or pass, the saturation point. Fresh oil may be introduced as the operation progresses, and the solvent capacity of fresh oil so introduced further assists in holding the unabsorbed pitch constituents in solution. The action of the absorbent material may also be supplemented by withdrawing part of the pitch laden oil formed by the cracking reaction as the operation progresses. For example, a part of the pitch laden oil may be withdrawn during the period just preceding the time at which the pitch concentration reaches the saturation point, and the withdrawal of tar may be continued for all or part of the remaining period of operation until the operation is terminated.

Fuller's earth has been found to be a particularly advantageous material to use in the process of the present invention. It can advantageously be charged into the still in an uncalcined condition, and the earth will be dehydrated during the bringing up of the still to cracking conditions, and the water present in the earth will be driven off along with the drips before the still reaches cracking conditions. Calcined earth can however be used. A bed of fuller's earth approximately 10 to 18 inches deep has been found satisfactory.

It will be evident that the pressure maintained during the cracking operation can vary, depending upon the character of the charging stock and other considerations. For example, with a gas oil charging stock, a pressure up to 90 to 100 lbs. per square inch or even up to 125 lbs. or more can be used. With a lighter kerosene charging stock, a higher pressure, e. g. from up to 125 lbs. to around 300 lbs. or more can be used with advantage. The pressure can be regulated by a pressure reducing valve maintained between the still and condenser, or the condenser can likewise be maintained under still

pressure, and the pressure regulating valve at the outlet of the receiver.

The character of the charging stock used in the process can also be varied. In particular, a charging stock which contains constituents which otherwise would tend to cause an increased deposit of carbon or coke on the heating surfaces can be used in the process and the apparatus of the present invention and their objectionable tendency overcome or greatly reduced, owing to the selective or preferential absorption of such impurities by the fuller's earth bed.

The following is an example of the practice of the present invention as carried out in a still of the character illustrated in the drawing:

The fuller's earth used was Olmstead fuller's earth of 16 to 30 mesh and the still was charged with 7 tons of the raw earth forming a bed approximately 18 inches deep on a perforated support of the character illustrated which was arranged approximately 2 feet above the bottom of the drum, the drum being about 9 feet in diameter and about 31.6 feet long. The still was charged with 8000 gallons of gas oil charging stock. The still charge was heated, drips were taken off, and the charge was brought to a working pressure of about 125 pounds. The still was then opened to the condenser and the distillate began to pass over. At about the same time, or shortly thereafter, the introduction of fresh charging stock into the still through the reflux tower was begun, the amount corresponding approximately to about 115% of the overhead distillate taken off. The rate of distillate taken off was about 820 gallons an hour, and the rate of feed through the tower was about 940 to 950 gallons an hour. During the run, tar was withdrawn at a rate corresponding approximately to about 15% of the overhead distillate. The rate of circulation through the heating tubes was about 2000 gallons a minute. About 31,000 gallons of pressure distillate of 47.5° Baumé gravity was obtained from a throughput of about 43,700 gallons representing a yield of about 71% of the charge as pressure distillate.

Where the withdrawal of tar, even though in relatively small amount, is omitted the period during which the operation can be carried out without objectionable carbon deposit is somewhat reduced. The operation is preferably conducted to a point such that the charge remaining in the still can be withdrawn in a fluid condition. Where the operation has been carried to a point such that the unabsorbed pitch in the oil materially exceeds the saturation point, part of the pitch-like constituents present in the remaining charge will be in solution and part in suspension.

In carrying out the process of the invention, an increased percentage of the charging can be taken off as distillate, the fuller's earth inhibiting the formation of objectionable carbon deposit. When the still is operated to obtain a higher percentage of the charge off as distillate, a somewhat more unsaturated product may be obtained and the amount of tar to be drawn off and to be redistilled or otherwise treated or disposed of will be less. In some cases, further treatment of the tar may be avoided. With higher percentages of the charge off as distillate, less heat is required in heating up the additional stock and more heat is available for cracking. With higher percentages of the charge off as distillate, a material saving in fuel may be effected, due to the greater percentage of distillate and also due to the decrease in time required to bring the still to cracking conditions of temperature and pressure for a given amount of charge. Where the tar is redistilled, a farther saving in fuel is effected, due to the decreased amount of tar withdrawn. The gasoline production can in this way be greatly increased per still per day, while at the same time prolonging the run and reducing the proportion of time now lost for shutting down and cleaning, and decreasing the fuel consumption.

We have used the same bed of earth in successive runs, with removal of only a few inches of the top layer and replacement of it with a fresh layer of earth. After continued use, however, the fuller's earth becomes spent or exhausted, and must be replaced by fresh earth. The spent earth can be regenerated, or may be otherwise utilized or disposed of. When a run is terminated, and the charge has been withdrawn and the still steamed out, we have found the top of the earth covered with a thin layer or crust composed of earth and pitch or coke, with the earth bed underneath dry and granular.

In the process of the present invention, the entire body of the charging stock and of the still charge is relied upon to hold in solution, until the saturation point is reached, such of the pitch-like or asphaltic constituents, formed by the cracking operation, as are not removed by the bed of fuller's earth. Such constituents of the charge as are converted into the pressure distillate constituents or pitch or asphaltic constituents will no longer be present to exert their solvent action upon the remainder of the charge; but with the progressive cracking of the charge and the gradual and progressive formation of the pitch-like constituents, the relative amount of such pitch-like constituents with reference to the remainder of the charge will progressively increase and the solvent capacity of the still charge for such pitch-like constituents will progressively decrease until saturation is reached. The operation is preferably terminated when the concentration of pitch-like constituents present in the charge exceeds

the saturation point to the extent that objectionable deposition occurs. The process of the present invention enables a prolonged run to be effected, enables a heavier charging stock to be more satisfactorily cracked, and also serves to protect the heating tubes from objectionable carbon deposit, as well as making it possible to take off a higher percentage of distillate.

We claim:

1. The improvement in the cracking of hydrocarbon oils by distilling a charge of the oil under pressure at a cracking temperature in a circulatory pressure still in which the oil is heated to a cracking temperature in a tubular heater, which comprises maintaining in said still charge a body of fuller's earth on a support adapted to permit free passage of oil and extending entirely across the charge of oil in the pressure still, withdrawing oil from beneath said support and discharging the oil directly into the charge of oil above said support and the material supported thereon, and continuing the operation until the pitch content of the still charge builds up at least to saturation.

2. The improvement in the cracking of hydrocarbon oils by distilling a charge of the oil under pressure at a cracking temperature in a circulatory pressure still in which the oil is heated to a cracking temperature in a tubular heater, which comprises maintaining in said still charge a body of absorbent material on a support adapted to permit free passage of oil and extending entirely across the charge of oil in the pressure still, withdrawing oil from beneath said support and discharging the oil directly into the charge of oil above said support and the material supported thereon, and continuing the operation until the pitch content of the still charge builds up at least to saturation.

3. The improvement in the cracking of hydrocarbon oils by distilling a charge of the oil under pressure at a cracking temperature in a circulatory pressure still in which the oil is heated to a cracking temperature in a tubular heater, which comprises maintaining in said still charge a body of filtering material on a support adapted to permit free passage of oil and extending entirely across the charge of oil in the pressure still, withdrawing oil from beneath said support and discharging the oil directly into the charge of oil above said support and the material supported thereon, and continuing the operation until the pitch content of the still charge builds up at least to saturation.

4. The improvement in the cracking of hydrocarbon oils by distilling a charge of the oil under pressure at a cracking temperature in a circulatory pressure still in which the oil is heated to a cracking temperature in a tubular heater, which comprises maintaining in said still charge a body of desulfurizing material on a support adapted to permit free passage of oil and extending entirely across the charge of oil in the pressure still, withdrawing oil from beneath said support and discharging the oil directly into the charge of oil above said support and the material supported thereon, and continuing the operation until the pitch content of the still charge builds up at least to saturation.

5. The improvement in the cracking of hydrocarbon oils by distilling a charge of the oil under pressure at a cracking temperature in a circulatory pressure still in which the oil is heated to a cracking temperature in a tubular heater, which comprises maintaining in said still charge a body of fuller's earth on a support adapted to permit free passage of oil and extending entirely across the charge of oil in the pressure still, withdrawing oil from beneath said support and discharging the oil directly into the charge of oil above said support and the material supported thereon, feeding fresh oil to the pressure still, and continuing the operation until the pitch content of the still charge builds up at least to saturation.

6. The improvement in the cracking of hydrocarbon oils by distilling a charge of the oil under pressure at a cracking temperature in a circulatory pressure still in which the oil is heated to a cracking temperature in a tubular heater, which comprises maintaining in said still charge a body of fuller's earth on a support adapted to permit free passage of oil and extending entirely across the charge of oil in the pressure still, withdrawing pitch-laden oil from the pressure still and continuing the operation while controlling the withdrawal of pitch-laden oil to cause the pitch content of the still charge to build up at least to saturation.

7. The improvement in the cracking of hydrocarbon oils by distilling a charge of the oil under pressure at a cracking temperature in a circulatory pressure still in which the oil is heated to a cracking temperature in a tubular heater, which comprises maintaining in said still charge a body of fuller's earth on a support adapted to permit free passage of oil and extending entirely across the charge of oil in the pressure still, withdrawing oil from beneath said support and discharging the oil directly into the charge of oil above said support and the material supported thereon, feeding fresh oil to and withdrawing pitch-laden oil from the pressure still, and continuing the operation while controlling the feed of fresh oil and withdrawal of pitch-laden oil to cause the pitch content of the still charge to build up at least to saturation.

8. The improvement in the cracking of hydrocarbon oils by distilling a charge of the oil under pressure at a cracking temperature in a circulatory pressure still in which the oil is heated to a cracking temperature in a tubular heater, which comprises maintaining in said still charge a body of fuller's earth on a support adapted to permit free passage of oil and extending entirely across the charge of oil in the pressure still, withdrawing oil from beneath said support and discharging the oil directly into the charge of oil above said support and the material supported thereon, and continuing the operation until the pitch content of the still charge exceeds saturation.

9. The improvement in the cracking of hydrocarbon oils by distilling a charge of the oil under pressure at a cracking temperature in a circulatory pressure still in which the oil is heated to a cracking temperature in a tubular heater, which comprises maintaining in said still charge a body of fuller's earth on a support adapted to permit free passage of oil and extending entirely across the charge of oil in the pressure still, withdrawing oil from beneath said support and discharging the oil directly into the charge of oil above said support and the material supported thereon, continuing the distillation until the pitch content of the still charge builds up at least to saturation and thereafter withdrawing the remaining charge from the pressure still while in a fluid condition.

10. The improvement in the cracking of hydrocarbon oils under pressure in circulatory pressure stills in which the oil is heated to a cracking temperature in a tubular heater, which comprises circulating the still charge of oil from a drum or bulk supply tank, through heating tubes and back to the drum or bulk supply tank, distilling the circulating oil under pressure and at a cracking temperature, maintaining in the drum or bulk supply tank a body of fuller's earth, supported in the still charge upon a support adapted to permit free passage of oil and extending entirely across the charge of oil in the drum or bulk supply tank and dividing the same into upper and lower compartments, withdrawing the oil from the lower compartment below said support and discharging the oil from the heating tubes directly into the upper compartment above said support and the material supported thereon, and continuing the distillation until the pitch-content of the still charge builds up at least to saturation.

In testimony whereof we affix our signatures.

EUGENE C. HERTHEL.
HARRY L. PELZER.